

1 CHIP-ON-FILM PACKAGE FOR IMAGE SENSOR AND METHOD FOR
2 MANUFACTURING THE SAME

3
4 FIELD OF THE INVENTION

5 The present invention is relating to a package for image sensor, particularly to a
6 chip-on-film package for image sensor and method for manufacturing the same.

7 BACKGROUND OF THE INVENTION

8 Conventional image sensor includes a semiconductor chip with image sensing
9 function (it will be abbreviated as image sensing chip below) for sensor of charge
10 coupled device (CCD) or complementary metal oxide semiconductor (CMOS). The
11 active surface of the image sensing chip is relatively sensitive to dust, so that it needs to
12 be protected with a suitable package from invasion by dust and moisture. Conventional
13 method for packaging image sensing chip is firstly to carry an image sensing chip on a
14 hard medium such as leadframe or printed circuit board, then to be sealed by a glass
15 cover and a dam. Practically, the leadframe or printed circuit board in plate-shape or
16 strip-shape for image sensing chip shall be hard enough to form the dam during
17 packaging process.

18 Alternatively a flip chip on glass image sensor package was disclosed in U.S. Patent
19 No. 6,342,406. An image sensing chip is flip-chip mounted onto a transparent glass. The
20 transparent glass has conductive traces including signal input ends and signal output ends
21 that are connected to each other by the conductive traces and are formed on different
22 surface through vias in the transparent glass. After the image sensing chip is electrically
23 connected to the signal input ends of the transparent glass by bumps, the transparent glass
24 may be mounted to a printed circuit board with an opening, in other words, electrically
25 connect the image sensing chip with printed circuit board through the signal output ends
26 of the transparent glass. The transparent glass has to be pervious to light and has
27 double-sided electrical conduction, but it is difficult and costs high to make electrically

1 double-sided conductive traces on the transparent glass. Besides, a sealer will be
2 provided to seal between the image sensing chip and the transparent glass without
3 covering the image sensing region in the active surface. However, the size of the
4 image-sensing chip is almost same as that of the transparent layer, so that the sealer is
5 difficult to form by dispensing after electrically connecting the image sensing chip with
6 the transparent glass.

7 An image sensing device package was disclosed in U.S. Patent No. 6,071,760.
8 Connecting an image sensing chip are a plurality of inner leads. The inner leads extend
9 from an opening of flexible PI tape so that the image sensing chip is packaged by TAB
10 bonding and tape conveying. The inner leads are suspended from the opening which is
11 larger than the image sensing chip. Utilizing inner lead bonding (ILB) technique the
12 inner leads are thermally pressed onto the bumps of the image sensing chip by means of a
13 compression head. However, the image sensing chip is merely bonded to the suspended
14 inner leads, so that the stability of the inner leads after bonding are not good enough to
15 support the image sensing chip. Particularly, the request for horizontal control of active
16 surface of image sensing chip is extremely severe, any slope of active surface that is
17 caused while filling sealant is disadvantageous to the image sensor package.

18 SUMMARY

19 The primary object of the present invention is to provide a chip-on-film (COF)
20 package for image sensor, which includes an image sensing chip being flip-chip mounted
21 on a COF film having an opening. The opening is small than active surface of the
22 image sensing chip and larger than image sensing region in the active surface. The COF
23 film has flip-chip connect pads on a surface of the film around the opening to join the
24 image sensing chip, so that a filling material is easy to form periphery of the active
25 surface without covering the image sensing region.

26 The secondary object of the present invention is to provide a chip-on-film (COF)
27 package for image sensor, which includes a transparent glass and an image sensing chip

1 larger than an opening of the COF film to clip lower and upper surfaces of the COF film
2 respectively. A hermetic space is formed at the opening of the COF film so as to seal
3 the image sensing region of the light-sensing chip under COF tape packaging process.

4 The third object of the present invention is to provide a chip-on-film (COF) package
5 for image sensor having a filling material like ACP or NCP on the COF film for sealing
6 the gap including image sensing region and covering the flip-chip bumps of the image
7 sensing chip in order to enhance air tightness between image sensing chip and COF film.

8 In accordance with the present invention, a Chip-On Film package for image sensor
9 comprises a COF film, an image sensing chip and a transparent glass. The COF film
10 includes an insulating layer and a plurality of metal traces. The insulating layer has an
11 upper surface, a lower surface and at least an opening. The opening is smaller than
12 active surface of the image sensing chip and larger than image sensing region in the
13 active surface. Each metal trace possesses a flip-chip connect pads. The flip-chip
14 connect pads are disposed around the opening and attached on the upper surface, it is
15 better that the flip-chip connect pads are electroplated to cover a metal layer such as gold
16 or tin. The image sensing chip has a active surface and a plurality of flip-chip bumps
17 are formed on periphery of the active surface. The image sensing chip is flip-chip
18 mounted on the upper surface of the COF film, thereby to electrically connect the bumps
19 of the image sensing chip with the flip-chip connect pads of the COF film. The
20 transparent glass is fixed to the lower surface of the COF film corresponding to the
21 opening, so that a hermetic gap is formed by the transparent glass and the image sensing
22 chip. Preferably, before or after flip-chip mounting, a filling material, such as
23 anisotropic conductive paste (ACP), non-conductive paste (NCP), anisotropic conductive
24 film (ACF), non-conductive film (NCF), UV adhesive, or thermosetting filler, is disposed
25 on the upper surface of the COF film. The filling material is confirmed around the
26 opening in order to seal a gap between the COF film and the image sensing chip without
27 covering the image sensing region.

DESCRIPTION OF THE DRAWINGS

Fig.1 is a flow chart of manufacturing a chip-on film package for image sensor in accordance with the present invention.

Fig.2A to Fig.2D are cross sectional views of COF film during the steps of manufacturing process of the chip-on-film package for image sensor in accordance with the first embodiment of the present invention.

Fig.3A to Fig.3D are cross sectional views of COF film during the steps of manufacturing process of the chip-on-film package for image sensor in accordance with the second embodiment of the present invention.

Fig.4 is a cross sectional view of a chip-on-film package for image sensor in accordance with the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Referring to the drawings attached, the present invention will be described by means of the embodiments below.

According to the first embodiment of the present invention, as showed in Fig.1, a method for manufacturing a chip-on-film package for image sensor includes a step 1 of “providing a COF film”, a step 2 of “providing an image sensing chip”, a step 3 of “flip-chip mounting” and a step 4 of “bonding a transparent glass”. The chip-on-film package for image sensor as showed in Fig.2D is manufactured by COF tape package manufacturing process. The chip-on-film package for image sensor includes a COF film 10 with wiring pattern. The COF film 10 is obtained from a COF tape that can be rolled up and conveyed by reel to reel. The COF film 10 includes an insulating layer 11 and a plurality of metal traces 15. The insulating layer 11 is flexible and electrically insulating and has a thickness approximately several ten micrometers. The insulating layer 11, is made of polyimide, polyester or other material, has an upper surface 12, a lower surface 13 and at least an opening 14. In this embodiment, the metal traces 15 are formed on the upper surface 12 and each metal trace 15 possesses a flip-chip connect pad

1 16. The flip-chip connect pads 16 are disposed around the opening 14 and attached on
2 the upper surface 12. Preferably, formed on the connect pads 16 is a metal layer like
3 gold, tin by electroplating. A transparent glass 20 is fixed on the lower surface 13 of the
4 COF film 10 corresponding to the opening 14 by an adhesive film. An image sensing
5 chip 30 with an active surface 31 is flip-chip mounted on the upper surface 12 of the COF
6 film 10 corresponding to the opening 14. The active surface 31 includes an image
7 sensing region 33 and a peripheral region surrounding the image sensing region 33. A
8 plurality of pixels are formed on the image sensing region 33 to constitute a CMOS or
9 CCD chip. The opening 14 of the COF film 10 should be larger than the image sensing
10 region 33 but smaller than the active surface 31 in size. The image sensing region 33 is
11 encompassed by the opening 14 and is toward the transparent glass 20. A plurality of
12 flip-chip bumps 32 are formed on the peripheral region of the active surface 31 for
13 connecting the flip-chip connect pads 16 of the COF film 10. In this embodiment, the
14 flip-chip bumps 32 are non-reflowable conductive bumps that are made of gold, copper,
15 aluminum or other alloy. Preferably, a filling material 40 is dispensed on the upper
16 surface 12 of the COF film 10 for sealing the image sensing region 33 in a gap. The
17 filling material 40 is selected from the group of anisotropic conductive paste (ACP),
18 non-conductive paste (NCP), anisotropic conductive film (ACF), non-conductive film
19 (NCF), UV adhesive, underfilling material, B-stage resin or other thermosetting
20 compound, which is formed by liquid dispensing, potting or printing. In this
21 embodiment, the filling material 40 is an anisotropic conductive paste (ACP) or
22 non-conductive paste (NCP). Prior to curing the filling material 40, the filling material
23 40 is confined by the opening 14 for sealing the flip-chip mounting gap between the COF
24 film 10 and the image sensing chip 30 without covering the image sensing region 33.
25 Therefore, a hermetic gap is formed at the opening 14 of the COF film 10 to seal the
26 image sensing region 33 of the image sensing chip 30 by COF tape packaging technique.

27 According to the first embodiment, a COF film 10 is provided in the step 1 of

1 “providing a COF film” as showed in Fig.2A. The COF film 10 is formed from a COF
2 tape by reel-to-reel conveyance. The COF film 10 has an upper surface 12, a lower
3 surface 13 and openings 14 and connect pads 16 around the opening 14. Thereafter,
4 step 2 of “providing a image sensing chip” and step 3 of “flip-chip mounting” will be
5 executed. As showed in Fig.2B, a filling material 40, such as ACP or NCP, is attached
6 on the upper surface 12 of the COF film 10 for encompassing the opening 14 prior to the
7 step3 of “flip-chip mounting”. As showed in Fig.2C, the provided image sensing chip
8 30 is flip-chip mounted to the COF film 10, thereby the flip-chip bumps 32 of the image
9 sensing chip 30 are electrically connected to the flip-chip connect pads 16 of the COF
10 film 10. Because that the filling material 40 is an anisotropic conductive paste (ACP) in
11 the embodiment, conductive particles are contained inside the anisotropic conductive
12 paste (ACP) so as to vertically electrical conduct without welding relationship. The
13 flip-chip bumps 32 are unnecessarily welded with the flip-chip connect pads 16. After
14 step 3 of “flip-chip mounting”, the filling material 40 is cured to seal the flip-chip bumps
15 32 without covering the image sensing region 33 under confinement of the opening 14.
16 The joining between the COF film 10 and the image sensing chip 30 become stable, also
17 the horizontal of the active surface 31 of the image sensing chip 30 can be maintained.
18 Finally, step 4 of “bonding a transparent glass” is executed. As showed in Fig.2D, a
19 transparent glass 20 is attached to the lower surface 13 of the COF film 10 by adhesive
20 film 21 in a manner that a hermetic gap is formed between the transparent glass 20 and
21 the image sensing chip 30 corresponding to the opening 14 of the COF film 10. The
22 image sensing region 33 of the image sensing chip 30 is airtight in the hermetic gap.
23 The all four steps mentioned above are executed and conveyed by a COF tape for COF
24 tape packaging process. Finally, each chip-on-film package for image sensor is formed
25 after singulation. According to the method of the present invention, not only the active
26 surface 31 of the image sensing chip 30 won’t be easy to slope during COF packaging
27 process in reel-to-reel tape conveyance, but also the image sensing region 33 of the image

1 sensing chip 30 can be sealed by a filling material 40 during the COF packaging process.

2 In the second embodiment of the present invention, another chip-on-film package
3 for image sensor is showed in Fig.3D is described as followed. The components in COF
4 package being same or similar to those used in the first embodiment are presented by the
5 same elements number, such as COF film 10, transparent glass 20, image sensing chip 30.
6 The transparent glass 20 is adhered to the lower surface 13 of the COF film 10 by the
7 thermosetting adhesive 22 like UV adhesive that is formed by liquid dispensing. The
8 chip-on-film packaging process will be showed from Fig.3A to Fig.3D, the step 4 of
9 “bonding a transparent glass” will be followed after the step 3 of “flip-chip mounting”.
10 As showed in Fig.3A a COF film 10 with an opening 14 is provided from a tape. As
11 showed in Fig.3B the image sensing chip 30 is flip-chip mounted to the upper surface 12
12 of the COF film 10. The opening 14 is larger than the image sensing region 33 of the
13 image sensing chip 30 but smaller than the active surface 31. As showed in Fig.3C a
14 filling material 40 is dispensed on the upper surface 12 of the COF film 10 around the
15 opening 14 for sealing the image sensing region 33. As showed in Fig.3D, the
16 transparent glass 20 is adhered to the lower surface 13 of the COF film 10 by
17 thermosetting adhesive 22 that is formed by liquid dispensing. In this step 4, the COF
18 film 10 may be conveyed as the upper surface 12 facing up or the lower surface 13 facing
19 up, thereby a hermetic space is formed at the opening 14 for sealing the image sensing
20 region 33 of the image sensing chip 30.

21 In the third embodiment of the present invention, as showed in Fig.4, components
22 disclosed in another COF package for image sensor which are same or similar to those
23 used in the first embodiment are presented by the same elements number, such as
24 transparent glass 20, image sensing chip 30. The COF package for image sensor
25 includes a COF film 50, an image sensing chip 30 and a transparent glass 20. The COF
26 film 50 comprises an electrically insulating layer 51 and a plurality of metal traces 55.
27 The metal traces 55 are formed on the lower surface 53 of the electrically insulating layer

1 51 and each metal trace 55 connects a flip-chip connect pad 56 on the upper surface 52 of
2 the electrically insulating layer 51 by passing through via. The flip-chip connect pads
3 56 are disposed around the opening 54 and substantially attached to the electrically
4 insulating layer 51. The image sensing chip 30 is flip-chip mounted on the upper
5 surface 52 of the COF film 50. In this embodiment, the flip-chip bumps 32 of the image
6 sensing chip 30 are reflowable tin-lead bumps and mounted to the flip-chip connect pads
7 56. The active surface 31 of the image sensing chip 30 faces to the transparent glass 20,
8 the transparent glass 20 is corresponding to the opening 54 and fixed to the lower surface
9 53 of the COF film 50. In the step 4 of "bonding a transparent glass", a thermosetting
10 adhesive 22 formed by liquid dispensing like UV adhesive or flip-chip underfilling
11 material is used for dispensing at the perimeter of the transparent glass 20. The
12 thermosetting adhesive 22 flows on the upper surface 52 of the COF film 50 and covers
13 the flip-chip bumps 32 because of capillary effect. Then, the transparent glass 20 is
14 bonded to the COF film 50 by curing the thermosetting adhesive 22, thereby to simplify
15 the filling material 40 and keep the sealing efficiency around the opening 54 to seal the
16 image sensing region 33.

17 The above description of embodiments of this invention is intended to be illustrated
18 are not limiting. Other embodiments of this invention will be obvious to those skilled in
19 the art in view of the above disclosure.

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